Evaluation Based on Land Equivalent Ratio and Economic Advantage of Intercropped Indigofera and Pennisetum at different planting space

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Abstract-The point of this exploration was decides the economic advantage of intercropping *Indigofera zollingeriana* (*Iz*) and *Pennisetum purpureum* (*Pp*) based on land equivalent ratio. This experiment was led by Completely Randomized Design (CRD) with four treatment mix of establishing space, Iz with establishing space (1) 1.0m x 0.75m, (2) 1.0m x 1.25m, and Pp with establishing space (1) 1.0m x 0.5m, (2) 1.0m x 0.75m. Data collections were analyzed by disagreement analysis of variance and HSD test. The variables measured were land equivalent ratio (LER) and advantage economic ratio (AER). The results showed that planting space treatments had significant differences (P<0.01) on LER, and AER. The HSD evaluation showed that Iz was the predominant in many combinations establishing designs intercropping, *Iz* with extension 1.0m x 1.25m and *Pp* with extension 1.0m x 0.75m have highest LER and AER. It conclusion, that intercropping *Iz* with extension 1.0m x 1.25m and *Pp* with extension 1.0m x 0.75m are the most suitable based on LER and AER.
Keywords : *advantage economic, indigofera, pennisteum, planting space*.

I. INTRODUCTION

One of the coordinated soil richness the board rehearses that includes developing at least two yields all the while in a similar region is known as intercropping. This training has been utilized for a really long time and has assisted farming with accomplishing its targets. Similarly, intercropping structures are useful to the smallholder farmers in the low-input as well as high-risk environment of the wildernesses, where intercropping of oats and vegetables is extensive among smallholder farmers in light of the limit of the vegetable to add to settling the issue of declining levels of soil wealth [1]. Tropical grasses as the central wellspring head of feed is never satisfactory to accomodate nutritious capability at humblest 8% of unrefined protein [2]. Vegetables grows up excessively and accessible on the year, where those corner vegetables bring out foliage and could fabricate the prevalence of inferior quality grasses. The constructive outcomes of tree vegetable leaves can be credited to their elevated degrees of protein and has consolidated tannins content, which is known to frame edifices with dietary protein helping their break from the rumen and effective processing in the digestive organs [3].

The upside of intercropping of cardinal or bounteous harvests to further develop last yield relies upon spatial plans (intercropping design) of partaken crops [4]. A persuasive and organize strategy of expanding diverseness of an agroecosystem is intercropping exchange that aknowledges interchange between the people of the contradistinctive yields and enhancements [5]. Intercropping float total material diverseness made sure about the gradual planting of contradistinctive harvests during relating an open door [6]. Gathered nutritious conprehension in intercropping organizedwhole float evetualize spatially and transiently. Spatial nutritious understanding float be gathered made sure about the rising establishment mass, fix material superiorities in nutritious cognizance eventualize when crops in an intercropping exchange chalk up culmination nutritious expects at contradistinctive times. Then again, any combination chalk up inconsistency outcomes on the outturn of the parts under intercropping exchange [1].

Low quality feed of tropical grasses given by the rancher prompts low day to day gain of dairy cattle. The issue is supply of scavenges is lacking because of limit of room for rummage creation and rely upon the seasons especially in dry battery period. Indigofera zollingeriana adult extremely and accessible on the year, where those corner vegetables bring out foliage could be fabricated the prevalence of bad quality grasses. Indigofera species has considerables expect as searches for ruminants. It is a potentiality legume because it has a first-class aggrandizement [7] with high production [8] and nutritive value [9]. The application of this herb species accrued protein content of ration, dry matter complication degradability, and volatile fatty acid value in *in vitro* stomach representation [10].

Contest among blends is believed to be the significant perspective influencing yield as contrasted and lone editing of cereals. Species or cultivar determinations, cultivating proportions, and contest capacity inside blends might influence the development of the species utilized in intercropping frameworks in downpour took care of regions [11]. Various files like land identical proportion, relative swarming coefficient, serious proportion, genuine yield misfortune, financial benefit, and intercropping advantage have been proposed to portray rivalry inside and

monetary benefits of intercropping frameworks [12]. The purpose of this research was determines the advantageous economic of intercropping *Indigofera zollingeriana* (*Iz*) and *Pennisetum purpureum* (*Pp*) under coconut plantation based land equivalent ratio.

II. MATERIALS AND METHODS

A. Materials

Seeds of grass *Pennisetum purpureum* cv Mott (*Pp*) were obtained from Asassement Institute of Agriculture Technology (AIAT) of North Sulawesi. Seeds of legume *Indigofera zollingeriana* (*Iz*) were obtained from the Agrostology region of the institution of Animal Science, Bogor Agricultural University. *Indigofera* seeds sown on land had been processed as a nursery. Plant seeds that had grown well were then moved into the 2.5 kg plastic bag already filled with soil (one plant/plastic bag). Subsequently ontogenesis of two months in a medium plastic bag, the communicate was so transferred in to observational situation

B. Experimental Design

The observational situation in a machination proportion of 3m x 4m that had been clarified with 6 treatment of behaviour towards of planting placement with string placement of 1m apart. Three planting space *Iz* : (i) 1.0m x 0.75m, (ii) 1.0m x 1.25m. After two months Indigofera in plant site, *Pp* was planted. Two Planting space *Pp* : (i) 1.0m x 0.50m, and (ii) 1.0m x 0.75m. Intercropping having four combination and each was planted in three plot. The plot combination were: I_1= 1.0m x 0.75m *Iz* & 1.0m x 0.50m *Pp;* I_2= 1.0m x 0.75m Iz & 1.0m x 0.75m *Pp;* I_3= 1.0m x 1.25m *Iz* & 1.0m x 0.50m *Pp;* I_4= 1.0m x 1.25m *Iz* & 1.0m x 0.75m *Pp*.

Indigofera was harvested at $\pm$ 90 days after planting. Indigofera were defoliated at height level 100 cm above ground. Pennisetum were defoliated at height level 10 cm above ground. Samples representatives were dried at 60^0C for 48 hours. Samples were analyzed for dry matter, crude protein, and crude fiber following Association of Official Analytical Chemists (2005) procedure.

Data were analysed using analysis of variance (ANOVA) by MINITAB (Version 16). Honestly Significance Difference (HSD) was applied to investigate the influence of differentiation sorrounded by treatments. Significant differences were accepted if $P < 0.05$.

C. Economic Assumptions

We expect that one individual with an inspiration would be the best labor force for directing 1 ha of fields, 3,000,000 monthly rupiahs. Fee for renting land in Rp 4,000,000 annually per hectare. There are 10,000 Iz plants spaced 1.0 m x 1.25 m and 13,330 Iz plants spaced 1.0 m x 0.75 m in the mixed stand on that one hectare of land; Pennisetum with 16,600 plants spread out over a 1.0 m x 0.50 m; Pennisetum with 13,330 plants distributed 1.0 m x 1.25 m, taking into account the Rp cost of 2,500 per plant for indigofera seeds and the Rp cost of the seeds 500.-/clump.

D. Examination of economic advantage

The examination of economic advantage of intercropping I*ndigofera zollingeriana* with *Pennisetum purpureum* CV Mott at different planting distances can be measured through total productivy and economic benefit.

1. Land Equivalent Ratio

The most widely used index for measuring land productivity in intercropping is the land equivalent ratio (LER). According to Brintha and Seran [13], it is frequently used as a measure of intercropping's effectiveness. According to Mead and Willey [14], the relative area required by sole crops to produce the same yield as intercrops is the LER, which is a standardized index.The following formula was used to determine the LER, which is the ratio of land needed by pure (sole) crop to produce the same yield as intercrop:

$$LER = \frac{Yiz \text{ in mixed stand}}{Yiz \text{ in pure stand}} + \frac{Ypp \text{ in mixed stand}}{Ybh \text{ in pure stand}}$$

Where : LER = Land equivalent ratio,
Yiz = dry matter yield of *Indigofera zollingeriana,*
Ybh= dry matter yield of *Pennisetum purpureum* cv Mott

2. The economic advantage (EA)

The economic advantage (EA) is another way to assess competition between different species. The EA gives more desirable competitive ability for the crops and is also advantageous as costs. Then, the EA was calculated using the following formula:

$$EA = = \frac{1 - LER}{100} \text{ x } LR$$

where LER = land equivalent ratio

LR = Land rental costs (ha/year), respectively.

III. RESULTS AND DISCUSSION

A. Results

Land equivalent ratio

Statistical analysis of the data showed that the combination of intercropping systems had significant consequences on LER based on potential dry matter yield. An LER based on a potential dry matter yield of approximately 1,565 to 1,811 indicates that intercropping media will have 56.5% to 81.1% higher dry matter content than the corresponding media grown in pure media or single parent. In general, partial LER_*Indigofera zollingeriana* was lowest in combination planting space 1.00 m x 0.75 m *Iz* and 1.00 m x 1.50 m *Pp* and partial LER_*Indigofera zollingeriana* was highest in combination planting space 1.00 m x 1.25 m *Iz* and 1.00 m x 0.75 m *Pp;* partial LER_*Pennisetum purpureum* was lowest in combination planting space 1.00 m x 0,75 m *Iz* and 1.00 m x 0.50 m *Pp* and partial LER_*Pennisetum purpureum* was highest in combination planting space 1.00 m x 1.25 m *Iz* and 1.00 m x 0.50 m *Pp;* LER_Total was lowest in combination planting space 1.00 m x 0.75 m *Iz* and 1.00m x 0.50 m *Pp* and LER_Total was highest in combination planting space 1.00 m x 1.25 m *Iz* and 1.00m x 0.75 m *Pp* (Table 1).

Table 1. Land Equivalent Ratio and Economic Advantage of Intercropping

Planting space		**Variable**			
Indigofera	Pennisetum	Land equivalent ratio			EA
		Indigofera	Pennisetum	Total	(Rp. 000.000)
1.00m x 0.75m	1.0m x 0.50m	0,746^{c}	0,819^{b}	1,565^{b}	2.262^{b}
	1.0m x 0.75m	0,803^{b}	0,823^{b}	1,626^{b}	2.502^{b}
1.00m x 1.25m	1.0m x 0.50m	0,843^{b}	0,949^{a}	1,793^{a}	3.171^{a}
	1.0m x 0.75m	0,963^{a}	0,849^{a}	1,811^{a}	3.245^{a}
P value		<0.001	<0.001	<0.001	<0.001
SE Mean		0.0125	0.0116	0.0153	0.0611

^{a,b,c} Means in the same row with different letters show differences (p<0.05). EA:Economic advantage, SE: standard error

Economic advantage

- *Economic Advantage of Intercropping*

In all mixes of indigofera and pennisetum intercropping frameworks will get a higher benefit when contrasted with establishing in monoculture. Where the highest benefit is acquired in combination planting space 1.00 m x 1.25 m *Iz* and 1.00m x 0.75 m *Pp* of Rp. 3.245 or approximately 81.10%, was followed by the combination planting space 1.00 m x 1.25 m *Iz* and 1.00m x 0.50 m *Pp*, which generated a profit of Rp. 3.171 or around 79.30% and combination planting space 1.00 m x 0.75 m *Iz* and 1.00m x 0.75 m *Pp* with a benefit of Rp. 2.502 or roughly 62.60%, while combination planting space 1.00 m x 0.75 m *Iz* and 1.00m x 0.50 m *Pp* yields the lowest profit, Rp. 2.262 or around 56.50% higher than the monoculture editing framework.

B. Discussion

In intercropping structures, extended supplement take-up can happen spatially and briefly. Crops in an intercropping framework enjoy fleeting benefits in supplement take-up when they have top supplement requests at various times, and root mass can increment spatial supplement take-up [15]. Exactly when the tree vegetable leaves were associated with the eating schedule, feed utilization, live weight gain, and feed change all chipped away at due to the better edibility. Join minor elephant grass, Gliricidia sepium, Leucaena leucocephala and Indigofera zollingeriana, to the extent that standards, the goats managed the tree vegetable Indigofera zollingeriana recorded the best execution [16].

Intercropping enjoys the benefit of utilizing restricted assets like light, supplements, and water [17]. The lavishness speed of the creating medium and a couple of biotic biological components influence plant supplement association. Extended thickness and supplement essentials and competition from light are exacerbated by short distances. The bar's ability to retain supplements expanded because of the plant space's effect on the microenvironment (light, temperature, and humidity) [18]. Since light comes from over the plants, individuals who place their leaves over the leaves of their neighbors benefit straightforwardly from expanded photosynthetic rates and in a roundabout way by lessening their neighbors' development through conceal [19]. The number of branches decreased with a row spacing of 1.0 m x 0.5 m [20]. The wide dispersing between plants in lines most likely made it more straightforward for the plants to change over the captured sun based radiation into leaf creation [8]. In a coconut farm, Indigofera zollingeriana's laying out space impacted the leaf protein content, stem crude fiber content, and leaf unpleasant fiber content [18].

Intercropping work on the dirt's miniature climate [21]. Microorganisms in the dirt assume a significant part in the mineralization and preparation of supplements required for plant development, as well as in keeping up with the capability of the dirt. In light of differential rhizodeposition, the microbial neighborhood in the rhizosphere may move with plant species, dietary status of the plant, manganese openness, soil type, and mycorrhizal colonization. Expanding N in the dirt is the most proficient technique to build the yield of plant dry matter. Dantata [22] suggests that contingent upon the variation of the establishing design and the determination of yields that are viable, intercropping meaningfully affects the vegetative development of the part crops. Intercropping with vegetable is a positive agronomic practice to help crop creation. Plant development stage is impacted by establishing space. Lessening plant thickness with growing isolating causes plants to have a more long chance to cultivate their establishments and gather photosynthetic [18].

Intercropping can be a solution for separate agroecosystems by using more leguminous yields and moreover applying less mineral manures [23]. Crop efficiency and development could be supported through sensible intercropping [24], effective utilization of the assets water, nitrogen and radiation [25], macronutrients and micronutrients [23], yield quality [26] and bring down the harm brought about by infections and nuisances [27]. Benefits of intercropping vegetables with non-vegetables are figured out by the fundamental usage of resources due for non-challenge for a comparative resource strength [28].

Exploratory proof showed that plant cooperations subterranean are ordinarily more extreme than those over the ground and contest might restrict take-up. Supplements frequently happen in unambiguous zones of the dirt because of specific ecological circumstances (for example draining), the board rehearses (for example surface applied phosphates), or supplement solvency. Lined up with these distinctions, and frequently somewhat because of them, there are contrasts in root conveyance designs among plants and all through the dirt profile. The creators, further demonstrated as roots can likewise utilize soil assets in an unexpected way: In how the supplement prerequisite is fulfilled (vegetables use N, non-vegetables utilize NO-3 or NH+4). Various species might vary in their prerequisite for an asset. There are fourfold contrast between species for calcium fixation, twofold for potassium and phosphate and triple distinction for nitrogen focus [29].

Conversation around coconut manor was even more broad significant topic in peaceful abuse by virtue of this ware was put resources into spine economy at rancher level [30]. Searches dry matter complexity creation was contributed by foliage and stem development, which was bombastic by cell sectionalisation and prolongation. Both physiology handling was the area of piercing metabolous movement, including dry matter complexity total made certain about photosynthetic action usage of CO_2 environmental [31]. By implication, field land intrigued to mitigate condition changes, by virtue of beneficially overseeing tropical field frameworks might contain measures of soil natural carbon (SOC) adjust or even more greater to those under native tropical woodland [32].

IV. CONCLUSION

Based on the results of this study, it can be concluded that the most suitable for Land Equivalent Ratio and economic advantage intercropping evaluation based on dry matter yield in the size area of 1.00m x 1.25m *Indigofera zollingeriana* and 1.00m x 0.75m *Pennisetum purpureum* cv Mott as planting spacing under the coconut plantation.

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